

Each winter, thousands of plants are killed, especially in northern California, by the winter cold. However, enough survive through each winter to the following spring to serve as colonizers for the summer's growth, and to increase distribution. In spite of this natural seasonal control, water hyacinths should be watched carefully both by governmental water weed experts and by interested botanists.

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### NOTES ON ORYZOPSIS HENDERSONII (GRAMINEAE)

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Prior to 1966 the grass *Oryzopsis hendersonii* Vasey was known from only four collections. Three of these were from the vicinity of Mt. Clements in Yakima Co., Washington (Mt. Clements, *F. L. Henderson* 2249, 1892; Oak Ridge Rd., *D. B. Gray*, 1949; Oak Creek Game Range, *D. B. Gray & C. F. Martinsen*, 1950), the other from the Ochoco National Forest, Oregon (Trout Creek Basin, *D. C. Ingram*, 1916). In June, 1966, I discovered a large population north of Colockum Pass in NE Kittitas Co., Washington, extending the known range of the species northward 40 miles. Three more populations were found later, two in the early spring of 1967, along the north side of the Kittitas Valley in the vicinity of Ellensburg. These four new records, listed by my collection numbers, are as follows: 1450, on the Ellensburg-Wenatchee Rd. N of Clockum Pass, ca. 5 miles S of the Kittitas Co. line; 1465, 1466, 1467, stations one half mile apart along Trail Creek ca. 15 miles NE of Ellensburg; 1642, 1662, along Naneum Creek 9 miles N of Ellensburg; 1645, ridge top N of Hwy. 131, 3 miles E of Virden.

The first of these populations grew at 4,300 ft. elev., on a broad ridge top, in a nearly barren opening in mixed ponderosa pine-Douglas fir forest. The oryzopsis formed about 50% of the sparse vegetation in some portions of this area; the most common species with it was *Poa secunda* Presl. The other collections were made in similar habitats along the lower edge of the pine zone at about 3,000 ft. elev. Each population was found on rocky basaltic soil and occupied what appeared to be the driest site in the area.

The plants form low, dense, gray-green tufts up to 20 cm across and

are easily recognized in the field by this habit, even in the vegetative state. Previous descriptions indicate that the panicle branches are ascending or appressed. This is true of the upper ones, but as the culm continues to elongate during and after anthesis the lower branches may spread to an angle of ca.  $45-80^\circ$  to the main axis. This was observed in two populations in the field and in all plants that were taken from the field and grown at the University of Washington.

Cytological material was collected in the spring of 1967 from plants grown in Seattle. Root tips were treated and sectioned by the method Johnson (1945) used so that the karyotypes obtained would be comparable to those he studied in his cytotaxonomic treatment of the genus. Also, emerging panicles were fixed in Newcomer's fixative (Newcomer, 1953), rinsed in 70% alcohol, and stained with Snow's carmine (Snow, 1963). Permanent slides are filed with the voucher specimens at the University of Washington. From the root tips of plants from collections 1450 and 1465 I obtained counts of  $2n = 34$ , a number previously unreported for the genus; two of the chromosomes bear satellites (fig. 1). Counts of  $n = 17$ , made at various stages of meiosis in developing anthers, were determined in plants from each of the populations I found. No meiotic irregularities were observed and pollen from plants grown in Seattle was about 95% stainable with cotton blue in lactophenol.

It is generally recognized that *Oryzopsis* and *Stipa* are closely related, for each genus has some species with features that are used by taxonomists to characterize the other. In *O. hendersonii*, the presence of three, rather than two, lodicules, and the moderately differentiated callus may be considered stipoid features, as might also the convolute lemma, common in *Stipa*, but known elsewhere in *Oryzopsis* only in *O. asperifolia* Michx. Because of these morphological similarities to *Stipa*, and the chromosome number which is found in several species of that genus, the embryo was examined to see with which genus it correlated. Reeder (1957) pointed out that the embryo of *Oryzopsis* has a small epiblast, that of *Stipa* a large one that usually reaches the tip of the coleoptile, and that "the primary root is often bent at a rather sharp angle to the main axis of the embryo," a feature especially conspicuous in *Stipa*. I was able to confirm these conditions for *S. lemmonii* (Vasey) Scribn. and *O. exigua* Thurb. following the methods Reeder described. The embryo of *O. hendersonii* (fig. 1) compares well with that of the former species but not that of the latter, appearing distinctly stipoid. This might be considered as an indication of affinity to *Stipa*, but it should be noted that these alleged generic differences in embryology also break down in other species of *Oryzopsis*. For example, I observed the primary root of *O. miliacea* (L.) Benth. & Hook. to arise at nearly  $90^\circ$  to the axis; Bruns (1892) illustrated a large epiblast on *Piptatherum* ( $=$ *Oryzopsis*) *paradoxum* L.; and Kennedy (1899) illustrated the embryo of *Eriocoma cuspidata* Nutt. (*O. hymenoides* (Roem. & Schult.) Ricker) as having an epiblast extending nearly to the tip of the coleoptile, the

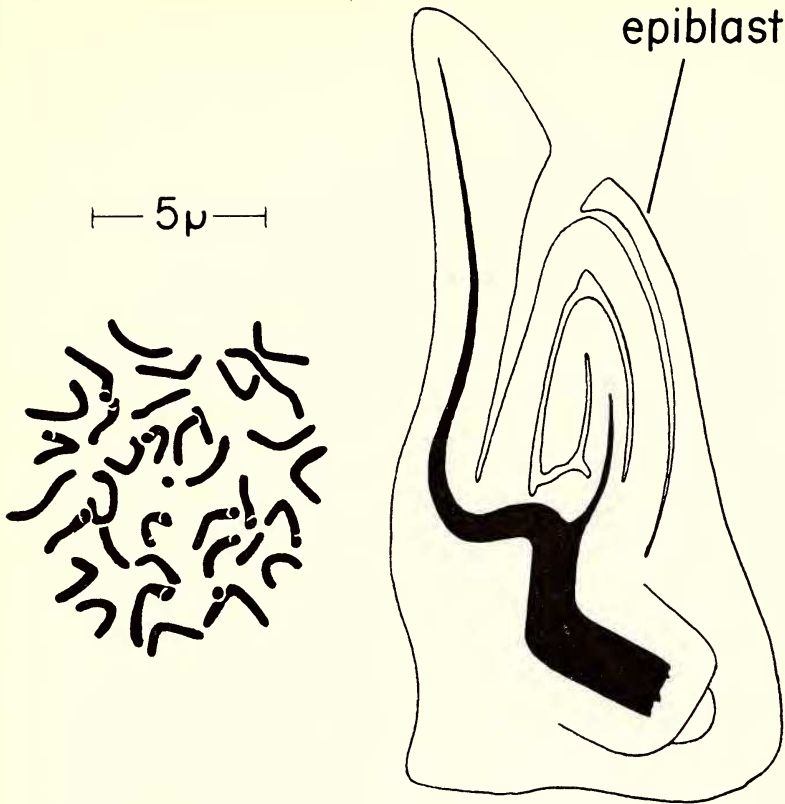


FIG. 1. Metaphase chromosomes from a root tip cell drawn with the aid of a camera lucida (left). Median longitudinal, section of embryo (right).

primary root arising at a sharp angle to the axis.

In his cytotaxonomic study of *Oryzopsis*, Johnson (1945) followed the conventional treatment in recognizing three sections, *Euoryzopsis*, *Piptatherum*, and *Eriocoma*. He found *Euoryzopsis* and *Piptatherum* to consist mostly of diploid species, those of the first section having  $2n = 22$  chromosomes, those of the second,  $2n = 24$ . Two species, *O. asperifolia* and *O. racemosa* (J. E. Smith) Ricker, were found to have a somatic complement of 46 chromosomes, and since they combine morphological features of both sections, he suggested that they were intersectional allopolyploids. In absence of cytological data, he discussed *O. hendersonii* with these two species because it has a similar combination of characteristics, indicating possible intermediacy between the two sections. Although I have found that its chromosomes are similar in length to those of the other two species and to the stipoid species in *Euoryzopsis*, it is unlikely that its complement (34) originated in the same way, followed necessarily by a loss of 12 chromosomes. However, if a basic number of 6 chromosomes, along with 11 and 12, is assumed in the early history of

*Stipa* and *Oryzopsis*, as has been suggested by Stebbins and Love (1941) and by Johnson, this complement may have arisen by allopolyploidy in one of the several ways they proposed for other members of these genera.

While having some features found in *Stipa*, *O. hendersonii* (sect. *Euoryzopsis*) shows possible affinities to section *Piptatherum* by the partly spreading panicle branches with distally placed spikelets, the wide, several-nerved glumes, and the dark, glabrous, dorsiventrally compressed, indurate lemma. Furthermore, the style branches, which are reflexed out of the side of the open floret at anthesis, resemble those of species in *Piptatherum* and also those of some species of *Stipa*, e.g., *S. lemmonii*. Johnson said that the form of the style branches (reflexed in *Piptatherum* but exserted from the tip of the lemma in *Euoryzopsis*) separates the two sections. Lacking critical material of *O. hendersonii*, he placed it in *Euoryzopsis*. Such disposition now appears to make that section somewhat unnatural, but the species does not fit well in any other subdivision of the genus either. Although it seems to occupy a fairly isolated position, I believe that removing it from *Euoryzopsis* would necessitate other subgeneric rearrangements. However, before such changes are made, further study of relationships within *Oryzopsis* is needed.

In summary, the information presented allows some speculation on the ancestry of *O. hendersonii*. Several morphological features indicate affinities to *Stipa*, but others reflect a relationship to *Oryzopsis* (sect. *Piptatherum*). Although native species in that section are not presently found in western U. S., Elias (1942) reported a fossil species of *Paleoeriocoma* from the Tertiary flora of Colorado which bears some resemblance to species in *Piptatherum*. The possibility that *O. hendersonii* is an allploid that originated from an ancient hybridization between *Stipa*-like and *Piptatherum*-like grasses is plausible if a basic number of 6, in addition to 11 and 12, is assumed for one or the other of these genera.

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